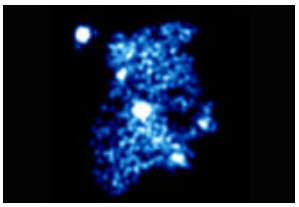

Chandra Finds Galaxy Growth Regulated by Big Black Holes

By SPACE.com Staff
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Mother Nature apparently has a weight limit for galaxies with supermassive black holes at their cores.

Astronomers using NASA's Chandra X-ray Observatory found a pair of large galaxies whose black hole centers appear to regulate their growth based on its amount of energy. If the energy level is high enough matter can avoid falling into the all-consuming black hole, too low and it gets gobbled up.

The research stems from observations of vast clouds of high-energy particles surrounding two large galaxies. The galaxies, known as 3C294 and 4C41.17, are 10 million and 12 billion light-years from Earth, respectively. Their energy clouds, researchers said, are the remains of past explosive events that stemmed from central supermassive black holes.

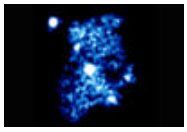
"These galaxies are revealing an energetic phase in which a supermassive black hole transfers considerable energy into the gas surrounding the galaxies," said Andrew Fabian, lead author of the study on 3C294, in a written statement. "This appears to be crucial in explaining the puzzling properties of present-day galaxies, especially those that group together in large clusters," he said. Fabian, a professor at Cambridge University, will publish his findings in an upcoming issue of the ***Monthly Notices of the Royal Astronomical Society***.

The studies of both galaxies suggest a kind of a cosmic circle of galactic life. As a dense region of intergalactic gas cools, it forms several smaller galaxies that later merge to form a larger galaxy with a supermassive black hole at its core. Both galaxy and black hole continue to grow by absorbing other nearby galaxies.

This growth, however, appears to halt when energy generated by the jets produced around the black hole heat up the galaxy's gas until it is energetic enough to avoid being sucked into the cosmic pit. This seems to occur once a galaxy reaches a mass about 12 times that of our own Milky Way, researchers said.

Millions of years after the jet activity dies down, matter again starts falling into the black hole and the cycle starts all over again, with the galaxy

Images



Chandra X-ray Observatory images of two distant massive galaxies show they are enveloped by vast clouds of high-energy particles that are evidence for past explosive activity. In both galaxies radio and X-ray jets allow this activity to be traced back to central supermassive black holes. The jets are heating gas outside the galaxies in regions hundreds of thousands of light years across. Click to enlarge.

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growing in fits like a car in stop-and-go traffic.

Life Cycle of Black Hole Emissions Seen for First Time

"It's as if nature tries to impose a weight limit on the size of the most massive galaxies," said Caleb Scharf, lead author of the study on galaxy 4C41.17 and a professor at New York's Columbia University. "The Chandra observations have given us an important clue as to how this occurs. The high-energy jets give the supermassive black holes an extended reach to regulate the growth of these galaxies," he said. Scharf's research will appear in the ***Astrophysical Journal***.

These magnetized jets of high-energy particles sweep up clouds of dust and gas and help trigger the formation of billions of new stars. The dusty, star-forming clouds of 4C41.17, the most powerful source of infrared radiation ever observed, are embedded in even larger clouds of gas.

Reseachers found these larger clouds to have a temperature of about 10,000 degrees. But the clouds are leftover material from the galaxy's formation and should have cooled rapidly by radiation in the absence of a heat source.

"Significantly, the warm gas clouds coincide closely with the largest extent of the X-ray emission," said Michiel Reuland of Lawrence Livermore National Laboratory in Livermore, Calif. Reuland is a a co-author on the 4C41.17 study. "The Chandra results show that high-energy particles or radiation can supply the necessary energy to light up these clouds," he said.

Most of the X-rays from 4C41.17 and 3C294 are caused by collisions of energetic electrons with the cosmic background photons from the early days of the universe. Because these galaxies are far away, their observed radiation originated when the universe was younger and the background was more intense. This effect enhances the X-radiation and helps astronomers to study extremely distant galaxies.

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